

ADVANTAGEOUS TRAITS OF HUNGARIAN TOMATO ACCESSIONS FOR FUTURE UTILIZATION

LÁSZLÓ CSAMBALIK¹, MÁRTA LADÁNYI², ESZTER TÓTH¹, ANNA DIVÉKY-ERTSEY¹

¹Szent István University, Faculty of Horticultural Sciences, Department of Ecological and Sustainable Production Systems, 1118 Villányi út 29-43., Budapest, Hungary

²Szent István University, Faculty of Horticultural Sciences, Department of Biometrics and Agricultural Informatics, 1118 Villányi út 29-43., Budapest, Hungary
csambalik.laszlo@kertk.szie.hu

ABSTRACT

Due to its production and consumption volume, tomato is one of the most important vegetable of the World. Extensive efforts have been made to overcome genotypic difficulties that decelerated gradual increase of yield. Throughout this improvement, plant genetic resources (PGRs) with unfavorable vegetative and generative characteristics together with possibly valuable traits (e.g. rich flavor, outstanding nutritional content, uncommon fruit size, color, and shape, high adaptation to environmental extremities) have been lost. The side-effects of modern breeding progress, such as loss of flavor, lower nutritional content are measurable now in modern varieties. Tomato PGRs collected by gene banks are available for screening and for re-use of advantageous genes; for this, accession-level testing has to be executed.

The hypothesis of the present study was that the selected Hungarian tomato accessions have valuable yield characteristics, which can be utilized in future breeding programs.

In a three year (2012-2014) open field trial, four PGRs with pepper-shaped fruits were grown together with San Marzano variety as a reference point. The PGRs were the followings (place of origin in brackets): RCAT030271 (Kozárd), RCAT031255 (Soltvadkert), RCAT031257 (Gyöngyös), and RCAT060349 (Nagykátá). The location was the certified organic land of SZIE Soroksár Experimental and Educational Station, Hungary. The propagation material was provided by Research Centre for Agrobiodiversity (NöDiK), Tápiószéle. Weight of weekly yield was measured; the fruits were separated to three fractions, i.e. intact, cracked, and infected fractions. Coherences with weather parameters were also investigated.

The potential yield (summary of all fractions) of PGRs were comparable with that of San Marzano variety in 2012, however, the cracked fraction of PGRs were significantly higher. The arid weather of 2013 reduced the ratio of cracked fractions in the case of all PGRs and the variety. The extremely humid season of 2014 was favorable especially for RCAT031257, the intact fraction of which was significantly higher than those of San Marzano. The potential yield of PGRs, with the exception of RCAT060349, was two-fold higher than the value of San Marzano. It was concluded, that scanning Hungarian tomato PGRs for useful traits (e.g. high yield in weather extremities, novel fruit color and shape) is reasonable; these characteristics can possibly be utilized by future breeding efforts.

Keywords: landrace, plant genetic resources, marketable yield, abiotic disorders, breeding

INTRODUCTION

genetically overbred and produced in monocultures (...) – has been adapted to the environment that they together formed an organic unit” (ÁNGYÁN ET AL., 2003). Landraces can be characterized by a lower yield (MANSHOLT, 1909; ÁNGYÁN et al., 2003) and a higher fruit quality (ÁNGYÁN ET AL, 2003; GYULAI AND LAKI, 2005). These plant genetic resources (PGRs) are the elements of the extensive systems (ÁNGYÁN ET AL., 2003). According to ZEVEN (1998), landraces were produced over hundreds of years due to their high yield safety; new varieties were bred for high yield in an intensive agricultural system. The yield safety of landraces is provided by the genetic diversity of the given population – certain genotypes are unable to tolerate the environmental factors, while other

can survive. For this reason, landraces are produced all over the World, and this is the characteristic, which provided food for humankind over 10,000 years.

Popularity of traditional tomato types show a constant increase; consumers believe, that certain fruit characteristics, like ribbing, or odd shapes, correspond to better organoleptic content (TIGCHELAAR, 1986; MALE, 1999; CASALS ET AL., 2011; GARCIA-MARTÍNEZ, 2012). With the use of landraces, market diversification and satisfaction of consumer expectations can be executed. Furthermore, certain PGRs can fill market niches of special processing aims (ERTSEYNÉ PEREGI, 2011).

Like in the past and present, heterogeneous landrace populations can serve as important breeding materials in the future (ZEVEN, 1998; MÁRAI, 2010), therefore the maintenance of these phenotypes is an ongoing task. For the utilization of PGRs, the identification of the accession characteristics is inevitable, with special regards to genotypic and phenotypic ones (MAZZUCATO ET AL, 2010, TERZOPOULOS AND BEBELI, 2010).

MATERIAL AND METHOD

The characteristics of the selected four accessions are shown in *Table 1*. The propagation material was provided by Plant Biodiversity Center, Tápiószele. San Marzano variety was used as the control variety of the experiment, the fruits of which are elongated with blunt tip and narrow shoulder.

Table 1. RCAT code, origin and fruit characteristics of Hungarian tomato accessions selected for yield investigation

RCAT number	Origin	Year of acquisition	Fruit shape*	Fruit color
RCAT030271	Kozárd	1976	elongated	red
RCAT031255	Soltvadkert	1976	elongated	red
RCAT031257	Gyöngyös	1977	elongated	red
RCAT060349	Nagykát	2006	elongated	red

*According to UPOV TG 44/11 Tomato Descriptor

The experiment was run between 2012-2014 on the organic certified lands of SZIE Experimental and Educational Field, Department of Organic Farming. Seed sowing and seedling production was done in an unheated plastic tunnel. The open field spacing was (45+90) x 45cm, one plot consisted of ten plants. Due to four repetitions, one accession or variety was represented by 40 plants. The experimental area was covered by agrotexile and supported with drip irrigation system. The plants were supported with bamboo poles, the side-shoots were removed weekly. Harvest was executed in every week. Fruits were collected in full biological ripening, which were then sorted into three categories: intact, cracked and infected ones. These fractions were weighed, and the fruits were counted. An intact fruit was defined as with maximum 1 cm long wounded scar. The cracked fraction contained those fruits with longer scars, but without any infection. Finally, fruits in the infected fraction showed the visual symptoms of disease infection. The results were visualized in a figure, using kg/m² dimension.

For the statistical analysis of yield data, the values of three consecutive harvests were used, the one before peak harvest, the peak harvest, and the one after the peak harvest. The comparison was done with two-way MANOVA test, using Tukey or Games-Howell post-hoc test. The yearly data of fractions were analysed by Marascuillo-test. For the execution of the statistical analysis, IBM SPSS Statistics ver. 25 was used.

RESULTS

The weather conditions of the three experimental years were basically different. While the first year can be characterized as a typical Hungarian summer with long late summer period, the second one was extremely arid, and the third one was seriously humid. These weather extremities provided a good opportunity to investigate the response or investigated PGRs for unfavourable environmental conditions.

In general, the highest yields were given in the first year, followed by those in the third year (*Table 1*). The lowest results were shown in the arid second year. With regards to the biological yield potency, which contains all three fruit fractions, the results were between 4.3-6.2 kg/m² in the first, 0.9-1.9 kg/m² in the second, and 1.3-3.5 kg/m² in the third year. With the exception of the second year, San Marzano showed the lowest or second lowest values. RCAT031257 yielded the highest amount both in the first and second year, while the second arid year was unfavourable for this PGR due to the high occurrence of blossom end rot.

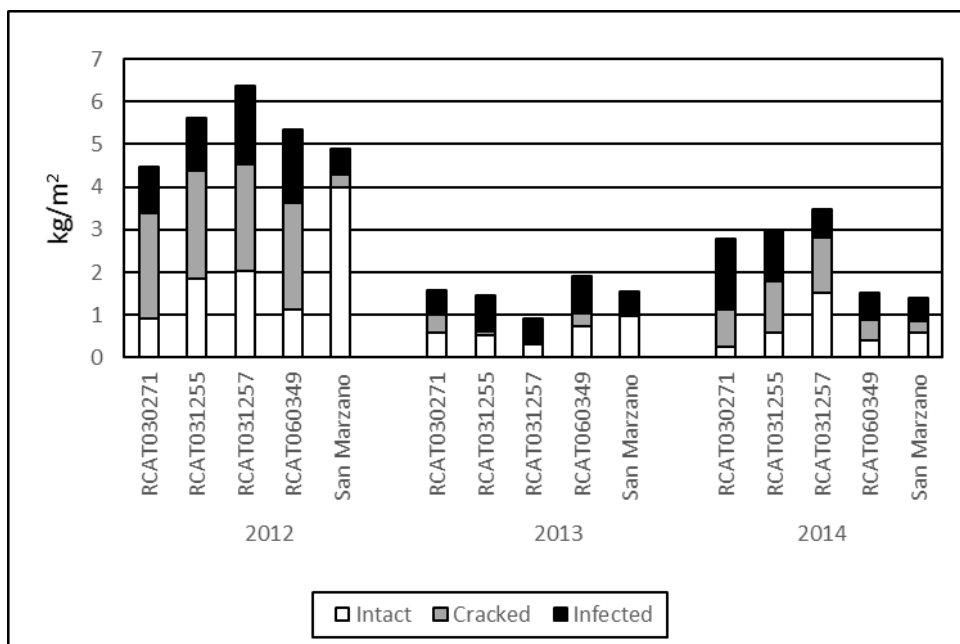


Figure 1. Intact, cracked and infected yield of tomato accessions and the variety over three experimental years (2012-2014)

Regarding the amount of intact fruits, weather conditions had a high impact on the results. In the first year, San Marzano had an outstanding amount of intact fruits, followed by RCAT031257 and RCAT031255. The second year was favourable for San Marzano again, while the weather of the third year ruined its results. In contrast, RCAT031257 could tolerate such extremities and gave the highest intact fruits among the investigated PGRs and the variety. Cracking was mainly the problem of PGRs, causing high wastes, especially in the first year. According to this, infections occurred more frequently on cracked fruits. However, RCAT031257 stands out again with its low infected fraction in the third year. On the other side, over half of the yield of RCAT030271 showed the symptoms of infection.

Due to the high standard deviation of the harvests, no significant differences were found among fractions either within a year, or between years.

CONCLUSIONS

It can be summarized, that yield parameters were highly weather-dependent; the most unfavourable situation is the shortage of precipitation.

In our study it was shown, that the total yield of PGRs are not necessarily lower than that of a commercial variety. However, cracking is a serious problem in the case of such accessions; with slight changes in consumer expectations, these wastes can at least partly utilized. The tolerance of certain PGRs to weather extremities is worth for further analysis.

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